Amendments to the Specification

The paragraph starting at page 1, line 16 and ending at line 20 has been amended as follows.

An inkjet printing method is a method of printing in which images are formed by ejecting ink in a single color or a plurality of colors prepared for color printing ~~on to~~ onto various printing media such as paper, cloth, unwoven fabric, and plastic films for OHPs.

The paragraph starting at page 1, line 21 and ending at page 2, line 9 has been amended as follows.

Inkjet printing apparatus employing this method include a so-called serial type inkjet printing apparatus having a carriage on which a printing unit (printing head) is mounted and which performs main scanning in a predetermined direction on a printing medium, a transport unit for transporting the printing medium in a direction different from the main scanning direction (sub-scanning), and a control unit for controlling those units. Ink is ejected from a plurality of ink ejecting openings provided on the printing head while performing serial scanning of the printing head in the main scanning direction. The printing head is transported a predetermined distance between serial scannings (e.g., a printing width that is achieved by one main scan and that is equivalent to the range in

which the ejection openings are arranged). Thus, printing is sequentially performed on the printing medium.

The paragraph starting at page 2, line 10 and ending at page 3, line 3 has been amended as follows.

Methods of supplying ink to a printing head used in an inkjet printing apparatus of this type include a method in which an ink tank is integrally or separably mounted on a printing head that is mounted on a carriage to be moved back and forth (main scanning) to supply ink to the same and a method in which an ink tank is provided separately from a printing head mounted on a carriage and is fixedly installed in a position in the printing apparatus other than the position of the head and in which ink is supplied by connecting the ink tank and the printing head through a flexible tube. Other methods include a method in which a supply system is configured such that ink is always or continuously supplied from an ink tank to a printing head in an amount in accordance with the amount of ejected ink and a method in which a printing head is provided with a reservoir section for reserving or storing a predetermined amount of ink (an amount to serve a sheet of printing medium, for example) and in which a supply system is configured such that ink is supplied at appropriate timing or intermittently to the reserving section from an ink supply source having a relatively great capacity.

The paragraph starting at page 3, line 4 and ending at line 13 has been amended as follows.

Recording methods called full-multi or line types are also known which utilize a printing head having a multiplicity of nozzles arranged in a range that corresponds to the entire width of a printing medium and in which printing is performed while transporting the printing medium relative to the printing head in the longitudinal direction thereof (sub-scanning direction). In the case of such a full-multi type apparatus, there is no mechanism for scanning a carriage, unlike a serial ~~type,~~ type; an ink tank is fixedly mounted in another part of the apparatus.

The paragraph starting at page 3, line 14 and ending at line 18 has been amended as follows.

Among such inkjet printing methods, the so-called drop-on-demand method in which printing is performed by ejecting ink directly ~~on to~~ onto a printing medium in accordance with printing signals is widely used as an easy and inexpensive method of printing.

The paragraph starting at page 4, line 9 and ending at line 20 has been amended as follows.

Inks used in inkjet printing apparatus are generally categorized into pigment type inks and dye type inks. Depending on purposes of use, some inkjet printing apparatus use dye type inks only; some inkjet printing apparatus use pigment type inks only; and some inkjet printing apparatus use both of dye type and pigment type inks. In some of inkjet printing apparatus that use both of dye type and pigment type inks, a pigment type black ink is used for printing of images that primarily ~~involves~~ involve black such as texts, and dye type color inks are used for printing of images that are primarily in colors such as those provided by a digital camera.

The paragraph starting at page 6, line 16 and ending at line 17 has been amended as follows.

However, such inkjet printing apparatus ~~has~~ have the following problems to be solved.

Please delete the paragraph starting at page 7, line 2 and ending at line 11.

The paragraph starting at page 7, line 19 and ending at page 8, line 1 has been amended as follows.

Assuming that an ink discharging condition is determined for a short physical distribution period, when a user actually installs and uses an ink tank that has been

distributed for a long time, the ink will be discharged only in the same amount as that discharged from an ink tank that takes a short time to be distributed. There will be an ink residue whose condition has changed in the ink chamber of the printing head, which can result in problems such as an ejection failure or disabled ejection in nozzles that are not in use.

The paragraph starting at page 10, line 14 and ending at line 23 has been amended as follows.

Fig. 6 is a graph showing distributions of pigment densities of a pigment ink having the same characteristics as those of the ink shown in Fig. 4, the distributions being observed by putting the ink in an ink tank configured such that its interior is fully occupied by a porous absorber in the form of a sponge contained therein to hold an ink with a capillary force thereof, letting the tank stand for 24, 12, 6, 3, and 0 ~~month~~ months with an ink supply hole thereof facing downward, and extracting the ink from the ink supply hole; and

The paragraph starting at page 12, line 2 and ending at line 17 has been amended as follows.

Reference numeral 11 represents a scanning rail that extends in a direction in which the printing head is scanned (main scanning direction) to slidably support the

carriage 2. Reference numeral 52 represents a carriage motor. Reference numeral 53 represents a drive belt that transmits a driving force of ~~a~~ the carriage motor 52 for moving the carriage 2 back and forth in the main scanning direction. Reference numerals 15 and 16 and reference numerals 17 and 18 respectively ~~present~~ represent pairs of transport rollers that are provided upstream and downstream of a position where printing is performed on a printing medium by the printing heads and that sandwich the printing medium to transport the same. Reference character P represents a printing medium such as paper. The printing medium P is urged against a guide surface of a platen (not shown) for regulating a printing surface of the medium such that it is kept flat.

The paragraph starting at page 13, line 2 and ending at line 12 has been amended as follows.

Referring to the recovery system unit in Fig. 1, reference numeral 300 represents ~~a~~ cap ~~unit~~ units that ~~is~~ are provided in association with the printing ~~head~~ heads provided at each of the four cartridges C and that can be elevated in the vertical direction. The cap units 300 are joined with the printing heads to cap them when the carriage 2 is in the home position, which prevents evaporation of the inks in the ejection openings of the printing heads, an increase in the viscosity of the inks, or an ejection failure attributable to evaporation, solidification and deposition of volatile components.

The paragraph starting at page 13, line 21 and ending at page 14, line 5 has been amended as follows.

Reference numeral 401 represents a preliminary ejection receiving section which is provided opposite to the home position with an area for a printing operation on the printing medium P interposed between them. Ink that is unsuitable or possibly unsuitable for printing is discharged by ejecting the ink from the printing head to the preliminary ejection receiving section 401 (preliminary ejection) at a proper timing. Further, a configuration may be employed in which the recovery system unit is provided with a blade constituted by an elastic member such as rubber to wipe condensation that ~~have stuck to~~ has formed on the ejection opening forming surfaces of the printing heads.

The paragraph starting at page 14, line 13 and ending at line 21 has been amended as follows.

In Fig. 2, a controller 200 serves as a main control section and has a CPU 201 in the form of a microcomputer, a ROM 203 in which fixed data such as programs and required tables are stored, and a RAM 205 having areas such as an area for arranging image data and a work area, for example. A host apparatus 210 is a supply source of image data ~~which~~ and may be a computer for generating and processing data such as image data to be printed and may alternatively be a reader for reading images or a digital camera.

The paragraph starting at page 15, line 5 and ending at line 11 has been amended as follows.

A head driver 250 is a driver for driving ~~an~~ electrothermal transducers (ejection heaters) 230 of the printing head according to printing data. Reference numeral 252 represents a motor driver for driving the carriage motor 52. Reference numeral 253 represents a motor driver for driving a motor ~~53~~ 54 commonly used for transporting the printing medium P and driving the pump unit 108.

The paragraph starting at page 15, line 24 and ending at page 16, line 15 has been amended as follows.

Various sensors may be used as the ink consumption detecting unit or remaining ink amount detecting unit, ~~eg~~ e.g., a sensor which is provided in the ink tank T to detect a level of ~~an~~ ink optically. Their functions may be provided as processes in the main body of the printing apparatus instead of using such a hardware-based configuration. Specifically, the ink consumption detecting unit may be means for calculating ink consumption by detecting the number of dots associated with the ink acquired from image data or detecting a value that is the amount of ink discharged on a preliminary basis expressed in terms of the number of dots, for example. The remaining ink amount detecting unit may be means for calculating the amount of remaining ink by subtracting the ink consumption from a predetermined ink tank capacity, for example. If employing

detecting means in which ink consumption or ink remaining amount is calculated as set forth above, a calculated value is to be reset or set at a predetermined value upon exchanging the ink tank T.

The paragraph starting at page 16, line 16 and ending at line 22 has been amended as follows.

The printing head 86 is formed with an ejection opening surface 1 having a plurality of ejection openings provided on the bottom of the same ~~that is shown lower~~ and cannot be seen in the figure. For example, an electrothermal transducer for generating thermal energy as energy to be used for ejecting ink is provided in a liquid path that is in communication with each ejection opening.

The paragraph starting at page 16, line 23 and ending at page 17, line 12 has been amended as follows.

The ink tanks T of the cartridges C ~~in Fig. 3~~ may contain dye type inks and pigment type inks depending on the specifications and characteristics of the printers. In general, when a pigment type ink having water-solubility lower than that of a dye type ink is contained, the ink can cause phenomena such as coagulation and settling of the coloring material after a long period of preservation of the same in the ink tank. When such a phenomenon occurs, the coloring material which has been distributed with a uniform

density in the ink tank T is changed in distribution such that the density becomes higher ~~the~~ closer to the bottom of the ink tank T in the attitude or orientation in which the tank is left standing. When a portion of the ink whose coloring material density has thus increased is supplied to the ejecting section of the printing head, ejection can become unstable or clogging can occur during supplying to disable ejection.

The paragraph starting at page 17, line 13 and ending at line 20 has been amended as follows.

Fig. ~~3~~ 4 is a graph showing a distribution of pigment densities of a certain pigment ink, the distribution being observed by putting the ink in an ink tank configured such that its interior is fully occupied by a porous absorber in the form of a sponge contained therein to hold an ink with a capillary force thereof, letting the tank stand for one year with an ink supply hole thereof facing downward, and extracting the ink from the ink supply hole.

The paragraph starting at page 18, line 13 and ending at page 19, line 2 has been amended as follows.

For example, let us assume that an image is printed using only color inks in yellow, magenta, and cyan. In the case of a pigment type black ink, when only normal preliminary ejection is performed to discharge the black ink from the printing head, the

black ink may be in a state in which a density error cannot be ~~dealt~~ corrected with normal ejection control. Therefore, preliminary ejection of an ink having a high pigment density can result in image problems such as disturbances in an image attributable to a reduction of the ejecting speed and voids in an image attributable to disabled ejection unless the ink is ejected in an amount greater than that of normal preliminary ejection to sufficiently discharge a portion of the ink that is in a state unsuitable for printing (i.e., a state that cannot be dealt with normal ejection control). For example, such a phenomenon can occur when a black image is printed after printing a great number of color images.

The paragraph starting at page 19, line 13 and ending at page 20, line 3 has been amended as follows.

According to such a method, however, when it is unknown how long an ink tank has not been used because no information is available on the manufacturing date of the ink tank, the discharging process must be performed on every ink tank on an assumption that they have not been used for a considerably long period since the manufacture of the same until the user obtains them through physical distribution and starts ~~using them~~ actually using them. Since the gradient of the density distribution tends to increase with the unused period, when a long unused period is assumed, a great amount of ink must be discharged until it can be considered that a stable density has been reached. As a result, a great amount of ink is discharged from even an ink tank which has reached the user ~~in~~ relatively soon after the manufacture of the same. That is, the running cost of any

ink tank is increased. The problem becomes more significant in a configuration in which a suction process is performed on all printing heads at a time.

The paragraph starting at page 20, line 4 and ending at line 10 has been amended as follows.

Under such circumstances, the present embodiment is intended to achieve efficient utilization of each ink by discharging inks in minimum required amounts at preliminary ejection before forming an image and performing preliminary ejection ~~in~~ during a series of subsequent image forming operations in accordance with the degree of use of each ink.

The paragraph starting at page 20, line 18 and ending at line 24 has been amended as follows.

At step S2, ~~as judging means,~~ a judgment is made on the received image data ~~by~~ as to whether there is a type (color or density) of ink that is not to be used to form the image among the inks loaded on the printing heads. The judging means may make the judgment based on ~~a~~ printing information such as a type of printing medium or a printing mode specified in association with the image data.

The paragraph starting at page 21, line 11 and ending at line 16 has been amended as follows.

It has been revealed that the pigment ink having the pigment density distribution shown in Fig. 3 provides a stable image when the image is formed after switching the number of ejections to a value which is about ten times the number of ejections ~~at~~ in normal preliminary ~~ejections~~ ejection during the image formation.

The paragraph starting at page 21, line 22 and ending at page 22, line 2 has been amended as follows.

When it is judged at step S4 that the current ink consumption n1 is greater than the ink consumption threshold, since it is considered that the ink has been consumed to enter a range of ink densities that allow stable image output, the number of ejections per unit time is set at step S7 such that normal preliminary ejections will be performed during image formation, and printing is started at step S9 after the printing medium is fed.

The paragraph starting at page 23, line 18 and ending at page 24, line 4 has been amended as follows.

In Fig. 5, a method is employed in which the number of preliminary ejections per unit time is increased to discharge an ink in a high density that resides in an

ink containing section. Alternatively, the amount of discharged ink may be increased by performing a preliminary ejection process at shorter time intervals or increasing the frequency of the preliminary ejection process. In the case of a printer having a configuration in which suction can be performed by joining cap units 300 with printing heads even when paper is ~~feed~~ fed as seen in the configuration in Fig. 1, the amount of discharged ink may be appropriately changed by discharging the ink using a suction process only or discharging the ink using a suction process and a preliminary ejection process in proper combination.

The paragraph starting at page 24, line 16 and ending at page 25, line 1 has been amended as follows.

As described above, the occurrence of image problems can be prevented when using an ink tank ~~that has spent~~ a long time after ~~being~~ it has been manufactured by setting a threshold in advance based on changes in physical and chemical properties of the used ink depending on the period of preservation and the degree of use of the ink. Further, even when using an ink tank ~~that has spent~~ not so long ~~time~~ after ~~being~~ it has been manufactured, it is possible to prevent the ink from being discharged in an unnecessarily large amount. That is, by using discharge on a discrete basis depending on the degree of use of inks during image formation, an extreme increase in the running cost is avoided, which makes it possible to provide a printer with an improved running cost.

The paragraph starting at page 25, line 21 and ending at page 26, line 3 has been amended as follows.

Fig. 6 is a graph showing distributions of pigment densities of a pigment ink having the same characteristics as those of the ink shown in Fig. 4, the distributions being observed by putting the ink in an ink tank configured such that its interior is fully occupied by a porous absorber in the form of a sponge contained therein to hold an ink with a capillary force thereof, letting the tank stand for 24, 12, 6, 3, and 0 ~~month~~ months with an ink supply hole thereof facing downward, and extracting the ink from the ink supply hole.

The paragraph starting at page 26, line 24 and ending at page 27, line 13 has been amended as follows.

The setting of the discharging amount of ink by discharging means such as a preliminary ejection process may be changed when the ink tank or cartridge is installed on the printing head. Specifically, the setting for the change may be made (the setting may precede step S1 in Fig. 5, for example) based on a table, which is separately created and in which initial amounts to be extracted, each of which is a required minimum for achieving a stable ink density, are ~~is~~ set, the initial amounts being set depending on elapsed times ~~similarly~~ similar to those in Fig. 7. Thus, the amount discharged on a preliminary basis can be changed during a series of image forming operations as described above depending on the time that has passed since the time of manufacturing a cartridge with the initial amount

discharged kept at the required minimum, which makes it possible to use each ink more efficiently and to achieve a further reduction of the running cost of each ink tank.

The paragraph starting at page 27, line 20 and ending at page 28, line 2 has been amended as follows.

When an ink consumption threshold specific to an ink is thus set such that it can be varied depending on the time that has passed since the time of manufacture, no image problem occurs even when using an ink tank ~~that spent~~ a long time after ~~being~~ it has been manufactured. Further, even when using an ink tank ~~that has spent~~ not so long ~~time~~ after ~~being~~ it has been manufactured, ~~is used,~~ there will be no increase in the running cost. This makes it possible to provide a printer with an improved running cost that depends on such an elapsed time.

The paragraph starting at page 28, line 15 and ending at line 22 has been amended as follows.

As described above, in an inkjet ~~recoding~~ recording apparatus utilizing an inkjet printing head and an ink tank for supplying ink to the inkjet printing head, the invention makes it possible to suppress image problems attributable to changes in physical and chemical properties of ink that occur during the time ~~spent by the ink~~ since it is

manufactured and until it is put in use and to thereby provide reliable and stable images at a low running cost.

The paragraph starting at page 28, line 23 and ending at page 29, line 3 has been amended as follows.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader ~~aspect~~ aspects, and it is the intention, therefore, ~~in~~ that the ~~apparent~~ appended claims ~~to~~ cover all such changes and modifications as fall within the true spirit of the invention.